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भारतीय मानक

# संभरकों के प्ररूप चयन की सिफारिशें

*Indian Standard*

# RECOMMENDATIONS FOR TYPE SELECTION OF FEEDERS

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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**Price Group 2**

Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee, HMD 6

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

Feeders constitute an important component in the material handling and conveying system involved in industrial units such as thermal power plant, stockyards, coal mines, fertilizer industry and chemical industry. They play a vital role in the operation of the plant as any operational problem relating to feeders can hamper the operation, growth and economy of industrial unit. This Indian Standard has therefore been brought out to help the industrial units and manufacturers, designers and consultants to assist them in proper selection of the type of feeders to be used for a specific application.

This standard is one of the series of standards being brought out on the selectlon of various types of feeders ( *see* **4** ). Other standards in this series are:

IS 12060 : 1987 Code of practice for selection of rotary vane feeders
IS 12108 : 1987 Code of practice for selection of rotary table feeders
IS 12204 : 1987 Code of practice for selection of reciprocating feeders
IS 12215 : 1987 Code of practice for selection of belt feeders
IS 12400 : 1988 Code of practice for selection of electromagnetic feeders
IS 12401 : 1988 Code of practice for selection of mechanical vibrating feeders

Types of feeders, for which no standards have yet been formulated to guide the industry for their selection, will be covered in due course of time.

In the preparation of this standard, assistance has been derived from the following publications:

Reiner (W) and Eisenhart Rothe (MV), Bins and bunkers for handling bulk materials—Practiced design and techniques.

Spivakovsky (A) and Dyachkov (V), Conveyors and related equipment.

Bolz ( Harold A ), Ed. Materials handling handbook. The Ronald Press Co, New York.

# *Indian Standard*

# RECOMMENDATIONS FOR TYPE SELECTION OF FEEDERS

## 1 SCOPE

This Indian Standard lays down brief description for application of various feeders and guidelines for selection of such feeders for handling solid bulk materials.

NOTE — Most commonly used feeders in various industries are belt, apron, screw, vibratory, reciprocating, rotary valve, rotary table and rotary plough feeders.

## 2 REFERENCES

The following standards are necessary adjuncts to this standard:

| *IS No.* | *Title* |
|---|---|
| 12108 : 1987 | Code of practice for selection of rotary table feeders |
| 12204 : 1987 | Code of practice for selection of reciprocating feeders |
| 12215 : 1987 | Code of practice for selection of belt feeders |
| 12400 : 1988 | Code of practice for selection of electromagnetic feeders |
| 12401 : 1988 | Code of practice for selection of mechanical vibrating feeders |
| 12960 : 1990 | Determination of power requirements of screw feeders — General requirements |
| 13324 : 1992 | Screw feeders — General requirements |

## 3 CHARACTERISTIC OF FEEDERS

Feeder is a device mounted at the outlet of storage units such as bins, bunkers, silos or hoppers to control the flow of material at a constant or variable rate.

## 4 TYPES OF FEEDERS

### 4.1 Belt Feeders

**4.1.1** Belt feeders may be horizontal or inclined. Belt speed is kept low. Belt feeders selected in accordance with IS 12215 : 1987 generally have the following parameters:

| | |
|---|---|
| Belt width | 400 mm to 2 400 mm |
| Belt speed | 0·1 to 1·2 m/s |
| Capacity | Up to 300 t/h |
| Length | 2 to 10 m |
| Power rating | Up to 45 kW |
| Lump size | Up to 300 mm |

**4.1.1.1** Inclination shall be taken into consideration while deciding the belt speed.

**4.1.2** *Application*

Belt feeders are commonly used to convey ores, coal or concentrates and occasionally are used to convey very fine dry powders. They can handle practically any material which is not large, hot or sticky. The advantages and disadvantages of using belt feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| Simple construction | More space requirement |
| Positive extraction of material | Not suited to hot, very abrasive, lumpy and sticky material |
| Good feed regulation | Fine powders which tend to flood can cause problems |
| Low power consumption | |
| Automatic control | |
| Low cost | |
| Can bear loading of material directly at feed point | |
| Less dust nuisance | |

### 4.2 Apron Feeders

**4.2.1** Apron feeders may be horizontal or inclined. The angle of inclination in case of apron feeder can be larger than that of a belt feeder. Apron feeder generally have the following parameters:

| | |
|---|---|
| Width | Up to 3 600 mm |
| Length | Up to 10 m |
| Maximum lumpsize | Up to 1 500 mm |
| Speed | 0·05 to 0·5 m/s |
| Capacity | Up to 4 000 t/h |
| Power rating | Up to 110 kW |

**4.2.1.1** Inclination shall be taken into consideration while deciding the feeder speed.

**4.2.2** *Application*

Apron feeders are predominantly used for handling heavy, large lumped and also for medium lumped materials. They can be used to handle stone, ores, gravel, sand, coal and other sharp, abrasive and hot materials. They are recommended for installation where material falls from a distance causing impact. The advantages and disadvantages of using apron feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| Large capacity | More spares requirement. Requires lubrication system |
| Positive feed extraction and uniform flow | High initial cost. Not suitable for powdered materials |
| Convey up hill | High maintenance |
| Reliable with difficult loads | High power consumption |
| Can handle large lumped, abrasive, sharp and hot material | Requires bed of fine material on the pans to be used under severe impact conditions |
| Can handle large chunks | Complicated construction |
| Impact resistance | Requires a dribble conveyor in some cases to collect fines falling through pan interfaces |
| Convey up to longer distance | |
| Can sustain heavy bin pressure | |

**4.3 Screw Feeders**

**4.3.1** A screw feeder is essentially designed for very low outputs. It may be horizontal or installed at a slight angle. A flow control valve regulates the capacity or dyno drive is used to control the capacity of the screw feeder. A multiple screw feeder may be added where material has tendency to pack under pressure. Screw feeders generally have the following parameters:

| | |
|---|---|
| Length | Up to 6·0 m |
| Diameter | Up to 360 mm |
| Capacity | Up to 60 t/h |
| Screw speed | *See* IS 13324 : 1992 |
| Power rating | Up to 22 kW when calculated in accordance with IS 12960 : 1990 |

**4.3.2** *Application*

Screw feeders are used for powdered, granular and small lumped materials that are not affected by crushing. It is not recommended for highly abrasive, highly aerated fines and sticky materials. The advantages and disadvantages of using screw feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| Provides dust tight enclosure | Limited capacity |
| Low head room requirement | Cannot handle large lumped and abrasive material |
| Assures positive movement of material | Not recommended for sticky materials |
| Comparatively low power requirement | |
| Low maintenance cost | |
| Ability to handle wide range of solids | |

**4.4 Vibratory Feeder**

**4.4.1** Two types of vibratory feeders generally used are:

a) Electro-mechanical; and
b) Electro-magnetic.

**4.4.2** Electro-mechanical vibratory feeder is driven by electric motor with accentric weights operating at a frequency of 1 500 cycles per minute with 50 c/s as line frequency. Electro-magnetic vibrator feeder is driven by electro-magnet. Their selection is generally guided by IS 12401 : 1988 and IS 12400 : 1988 respectively. They generally have the following parameters:

| *Parameter* | *Electro-Mechanical Feeder* | *Electro-Magnetic Feeder* |
|---|---|---|
| Line frequency | 50 c/s | 50 c/s |
| Frequency of vibration | 750-1 500 cycles p/m | 3 000 cycles p/m |
| Amplitute of vibration | 3 to 12·5 mm | 1 to 2 mm |
| Drive angle | 30-60 deg | — |
| Pan inclination | Up to 15 deg | Up to 15 deg |
| Pan width | Up to 2 500 mm | Up to 2 000 mm |
| Trough length | Up to 8 000 mm | Up to 4 000 mm |
| Capacity | Up to 3 000 t/h | Up to 1 000 t/h |
| Lumpsize | Up to 1 500 mm | Up to 200 mm |
| Power rating | Up to 75 kW | Up to 15 kW |

### 4.4.3 *Application*

Vibratory feeders are used for coarse, medium, fine and concentrated materials. Coal, iron ore, lime stone, rock, coke, scrap steel and other similar materials may also be handled by vibratory feeder. Dusting problems arises with dry powdered materials. The advantages and disadvantages of using vibratory feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| Simple construction | Feed extraction not positive |
| High capacity | Very fine and sticky material may cause problems |
| Automated control | Dusting problem with dry powdered materials |
| No spillage | |
| Uniform flow | |
| Shock absorbing suspension | |
| Offers possibility of scalping | |
| No lubrication required | |
| Very low power consumption | |
| Low intial cost | |
| Low installation cost | |

## 4.5 Reciprocating Plate Feeders

**4.5.1** Apart from handling lumps, reciprocating plate feeders also handle fines which do not get packed in the hopper opening. Reciprocating feeders operate horizontally or at slight declinations. Reciprocating feeders are generally selected in accordance with IS 12204 : 1987. They generally have the following parameters:

| | |
|---|---|
| Pan width | 315 to 2 000 mm |
| Stroke length | 100 to 450 mm |
| Strokes per minute | 20 to 60 |
| Maximum lump size | Up to 1 200 mm |
| Capacity | Up to 1 000 t/h |
| Power rating | Up to 40 kW |

### 4.5.2 *Application*

The plate feeders are most commonly used for discharging fine and medium materials. They are used under track hoppers and bins to handle stone, ores, coal and other non-sticky materials. Due to their simple construction and low cost, they are widely used in coal mining industry. The advantages and disadvantages of using reciprocating plate feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| Simple construction | High wear and tear |
| Low initial cost | High maintenance cost |
| Capability to handle all types of materials and lumps | Intermittent discharge |
| Not suitable for sticky material | |
| Speed adjustment | |

## 4.6 Rotary Valve ( Air Lock ) Feeders

**4.6.1** The rotary valve feeders are completely enclosed and presents powders or fine grained material from flooding. These feeders can control discharge rates of fine or granular free flowing, dry solid materials. These feeders are used for flow rate up to 300 $m^3/h$ with a maximum lump size of 30 mm.

### 4.6.2 *Application*

Valve feeders are normally installed underneath hopper/cyclone outlet and provides air lock. It can directly discharge into a pneumatic conveying line.

## 4.7 Rotary Table Feeders

**4.7.1** Rotary table feeders ( *see* IS 12108 : 1987 ) are suitable for sticky materials such as wet ore fines and low feed rates. It can accommodate hopper openings up to 2·5 mm in diameter. They can handle materials which have tendency to arch. They are simple in construction and require very little maintenance. These feeders are used for flow rate up to 350 $m^3/h$ with a maximum lump size of 30 mm. Their disadvantages include high installation cost.

## 4.8 Rotary Plough ( Paddle ) Feeders

**4.8.1** Rotary plough feeder has a wide field of application for materials like lignite, coal, potash, sinter, phosphate, lime stone, ore, cement clinker etc. Rotary plough feeders are suitable for use in funnels, under storage pipes, under long storage bins or under slotted hoppers. In slotted hoppers, the bulk materials form a layer on a cantilevered longitudinal shell. Rotary plough ( paddle ) mounted on self-propelled carriage and rotating on a motor driven vertical shaft force off the material from the shell and discharges into another belt conveyor. The paddle wheel travels slowly along the hopper and unloads it uniformly, reversing direction automatically when it reaches the end of the slot. Rotary paddle feeder is becoming more and more popular for unloading track hoppers. It is used for high capacity that is, up to 2 500 t/h. It has high initial cost.

**4.8.2** Plough feeders are available in following designs:

a) Single plough with single reclaim shelf for low capacity.

b) Single plough with double reclaim shelves for high capacity.

**4.8.2.1** In both the types defined in **4.8.2** (a) and **4.8.2** (b), the drive system can be either above or below the shelf.

**4.8.3** The elimination of multiple feeders with multiple loading points on reclaim belt also reduces continuous skirt boards and material spillage.

**4.8.4** The advantages and disadvantages of using rotary plough feeders are as follows:

| *Advantages* | *Disadvantages* |
|---|---|
| First-in-first-out system eliminates the danger of spontaneous combustion when handling materials such as coal | Higher initial cost |
| Fully live storage | |
| Suitable for all types of bulk solids | |
| Suitable for handling even cohesive solids | |
| Eliminates bridging and rat holing due to long slot opening which is experienced with other types of feeders | |
| Variable feed control | |

## 5 SELECTION OF TYPE OF FEEDERS

**5.1** The type and size of feeder for an application depends on capacity requirement and characteristics of the material to be handled. Installation details and few other factors also play important role in selection of feeders.

**5.2** The factors which shall be considered for selecting a feeder for required application are listed below:

a) *Material Characteristics*

i) Material
ii) Feed rate, maximum and minimum
iii) Bulk density
iv) Maximum lump size
v) Size analysis
vi) Moisture content
vii) Angle of repose
viii) Cohesiveness
xi) Temperature
x) Flowability
xi) Any other property that may affect the selection

b) *Installation and application details*

1) *Hopper details*

i) Surge hopper
ii) Overground/underground bunker
iii) Open stockpile
iv) Dumper unloading hopper, etc

2) *Process following the feeder*

i) Belt conveyor
ii) Crusher
iii) Screen
iv) Loading into trucks/rails/others, etc
v) Accuracy of flow regulation
vi) Control equipment for the process
vii) Maintenance requirements
viii) Economy.

**5.3** For guidance, Table 1 may be referred for selection of feeders based on material sizes.

**Table 1 Suitability of Feeders According to Size of Material Handled**

| Feeder | 1 000 and above mm | 500 to 1 000 mm | 300 to 500 mm | 150 to 300 mm | 50 to 150 mm | 12 to 50 mm | −12 mm | −100 Mesh | −200 Mesh |
|---|---|---|---|---|---|---|---|---|---|
| Apron | E | E | E | E | G | F | — | — | — |
| Belt | — | — | — | F | G | E | G | F | F |
| Rotary plough | — | — | F | G | E | E | E | — | — |
| Rotary Table | — | — | — | — | — | G | E | E | G |
| Screw | — | — | — | — | F | G | E | E | E |
| Vibratory Feeder ( Mechanical ) | G | G | E | E | E | G | F | — | — |
| Vibratory Feeder ( Magnetic ) | — | — | G | E | E | E | G | F | F |
| Reciprocating Feeder | G | G | E | E | E | G | F | — | — |

E : EXCELLENT
G : GOOD
F : FAIR

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